## ABSTRACT OF THE DISCLOSURE

[107] A method for optically analyzing blood vessel walls comprises receiving optical signals from the vessel walls and resolving a spectrum of optical signals in wavelength to generate spectral data. The spectral data is then transformed into the frequency domain. In the preferred embodiment, this transformation is achieved by applying wavelet decomposition. In other embodiments other transform techniques such as Fourier analysis is applied. The spectral data in the frequency domain are then used to analyze the vessel walls. In the typical embodiment, the spectral data are used to analyze a disease state of blood vessels walls such as the presence of atherosclerotic plaques, and their state. Dual domain method enables the spectral signals from blood vessels to be analyzed simultaneously according to frequency and wavelength (time). Dual-Domain Regression Analysis (DRDA) and Dual-Domain Discrimination Analysis (DDDA) in combination with wavelet transform (WT) enable the modeling of signals simultaneously in both domains. This provides a mechanism for isolating the non-interesting variation in spectra, making the system and analysis method more robust against variations in instrument and environmental conditions, *e.g.,* broad-band spectral variation contributed from water, heart motion, and other non-interesting interferences. This provides higher sensitivity and specificity when compared with other models currently being used.